

Portland's Stormwater Marketplace

Using Market Forces for Sustainable Stormwater Management

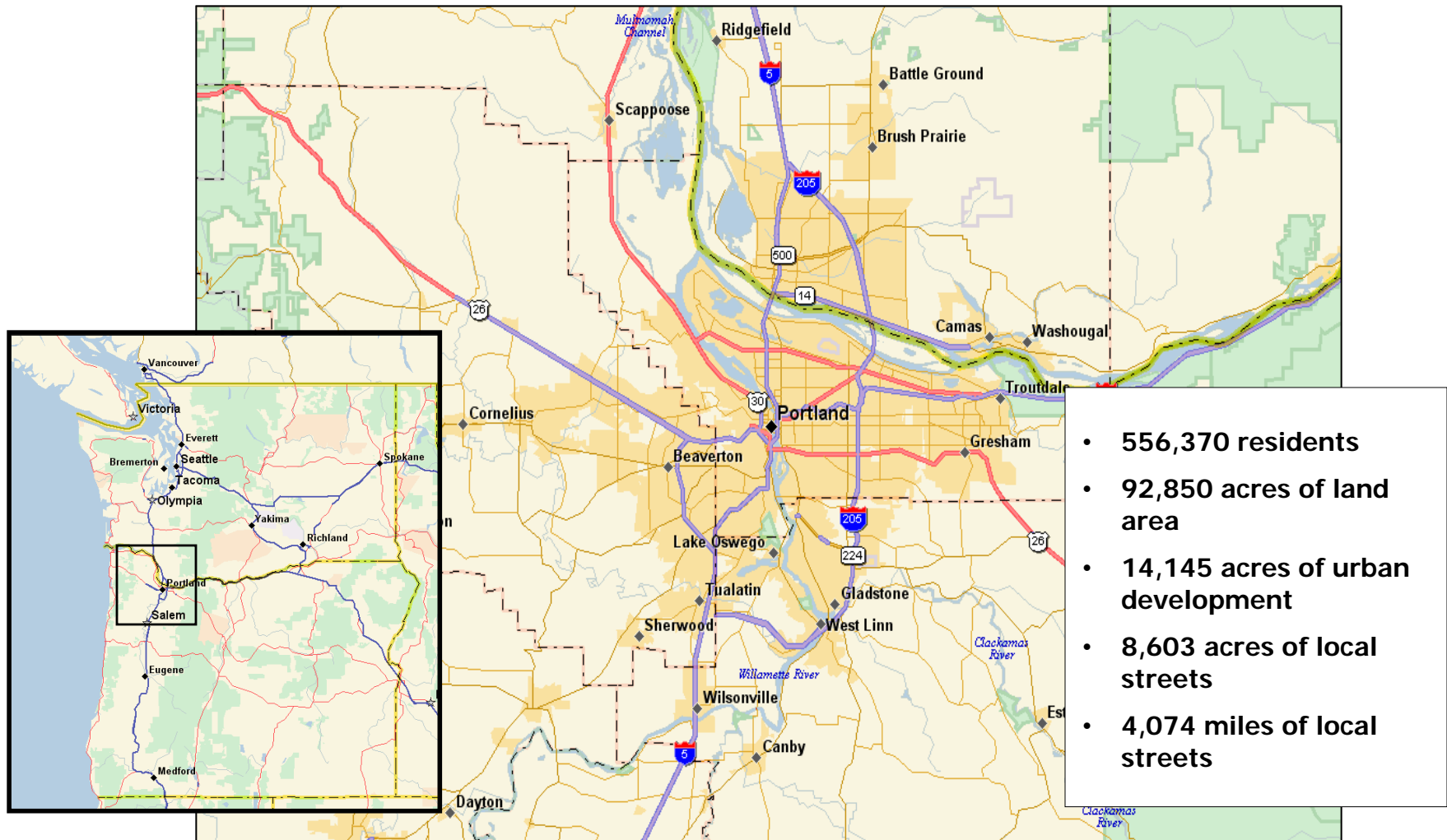
Collaborative Science and Technology Network for Sustainability Progress Workshop



Washington, DC – November 8-9, 2007

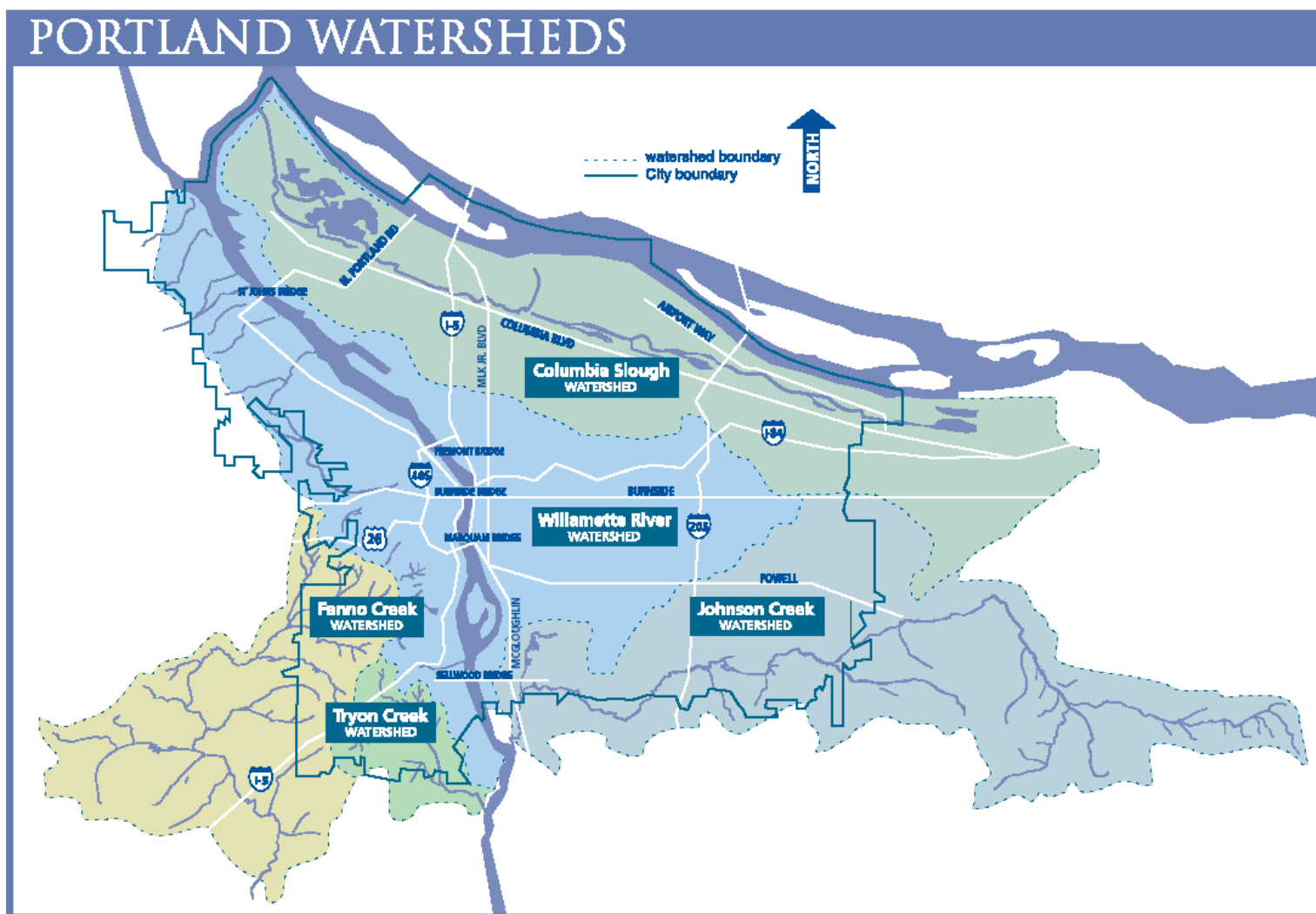
Ecotopia

Portland and the Left Coast



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Five diverse urban ecosystems

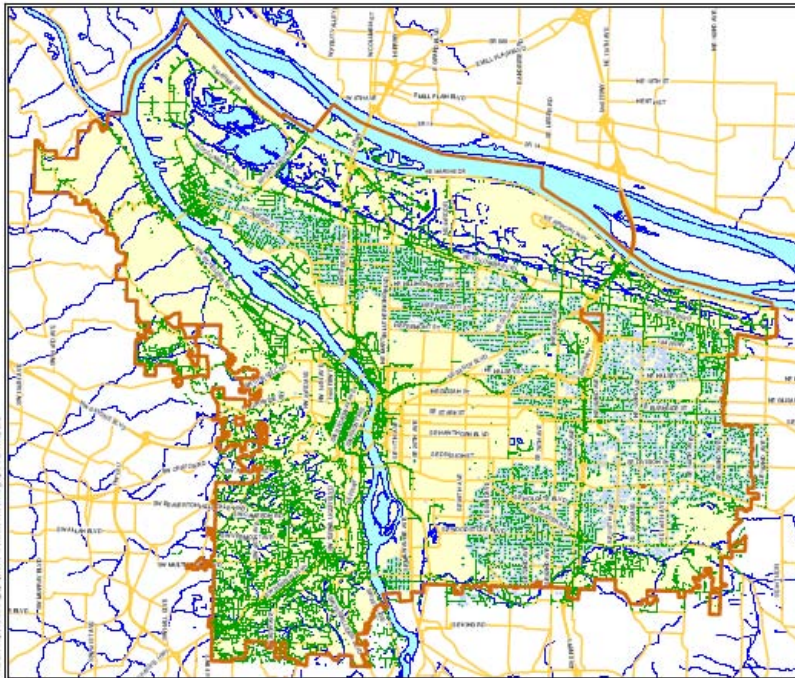
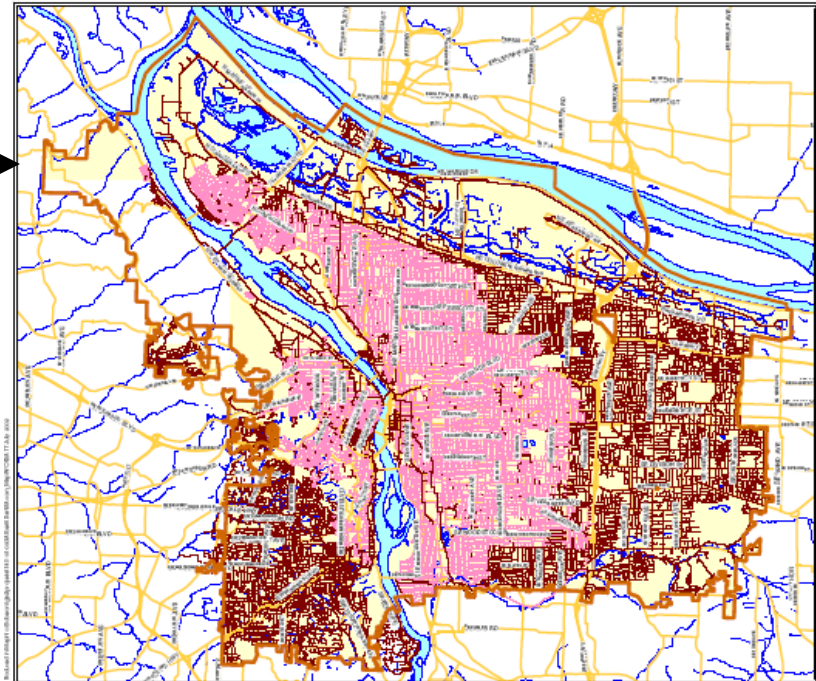


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Multiple Stormwater Management Systems

Systems based on Age and Geography

- 861 miles of combined sewers (pink)
- 932 miles of separated sanitary sewers (red)



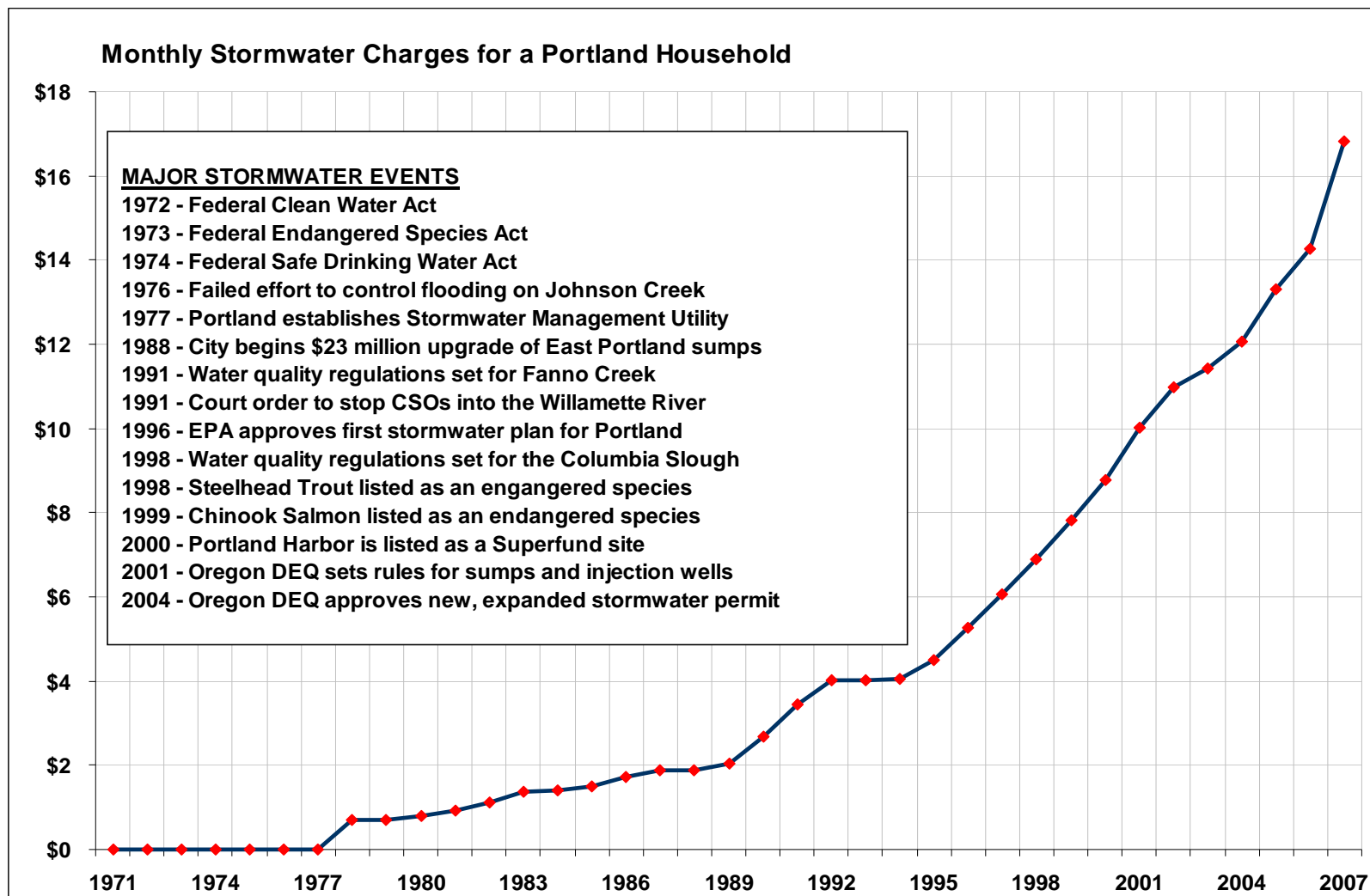
- 568 miles of separated storm sewers, storm channels, ditches and culverts (green)
- 9200 sumps (blue)



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Financial Reliance on Utility Rates

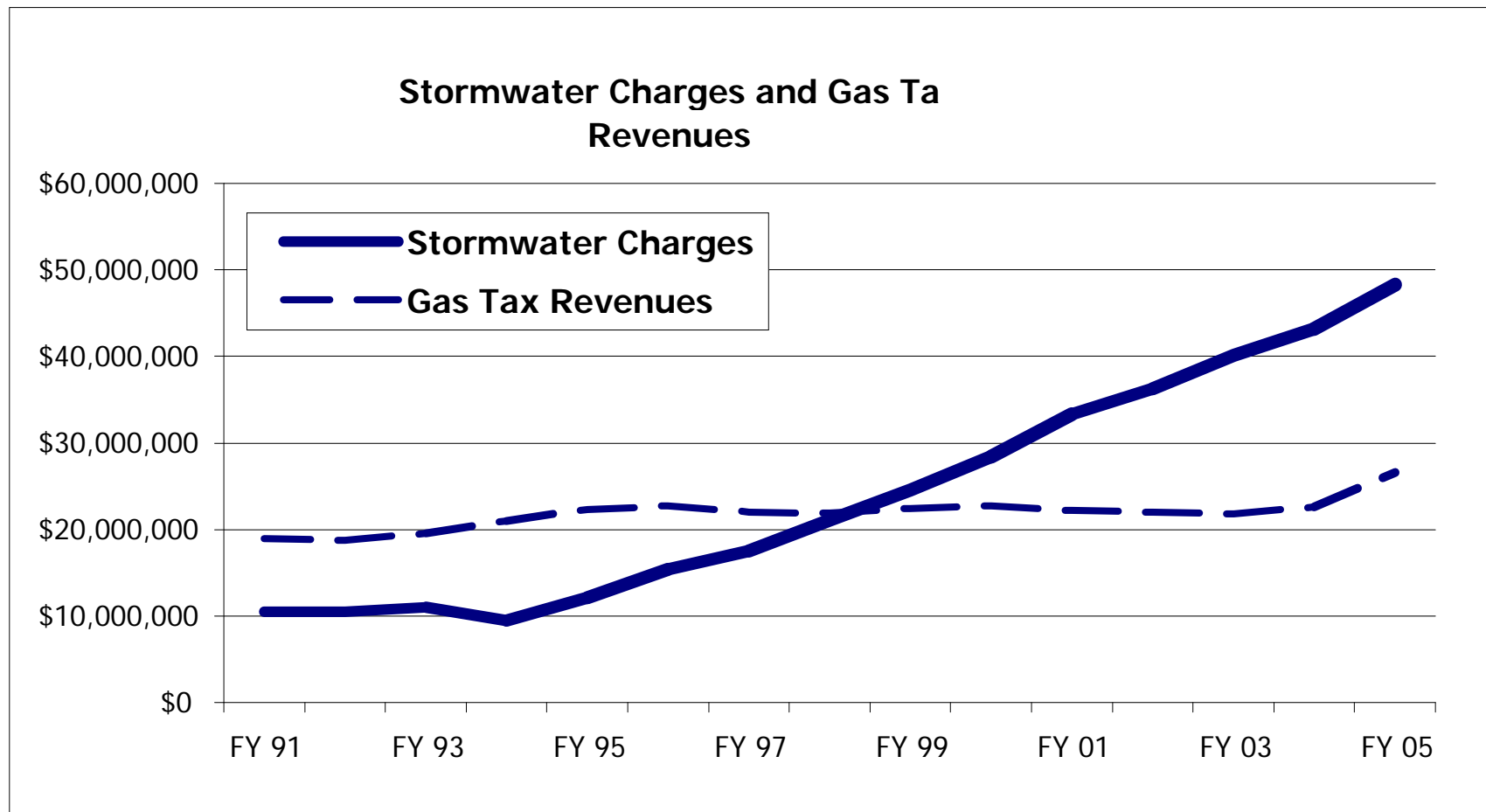
Utility investments and rates driven by City response to environmental regulations



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Shifting Financial Burdens

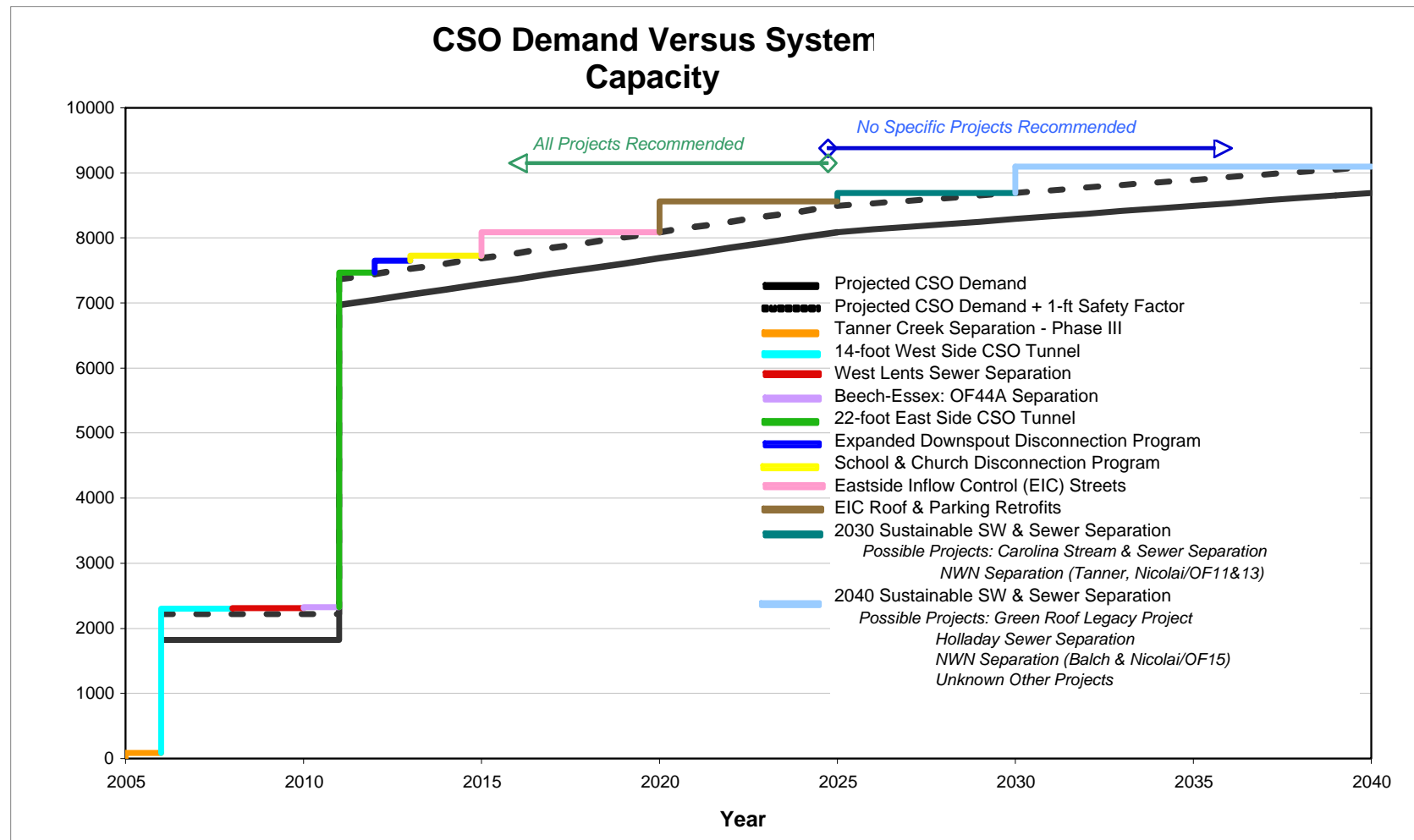
Street system drainage costs shifted to stormwater ratepayers



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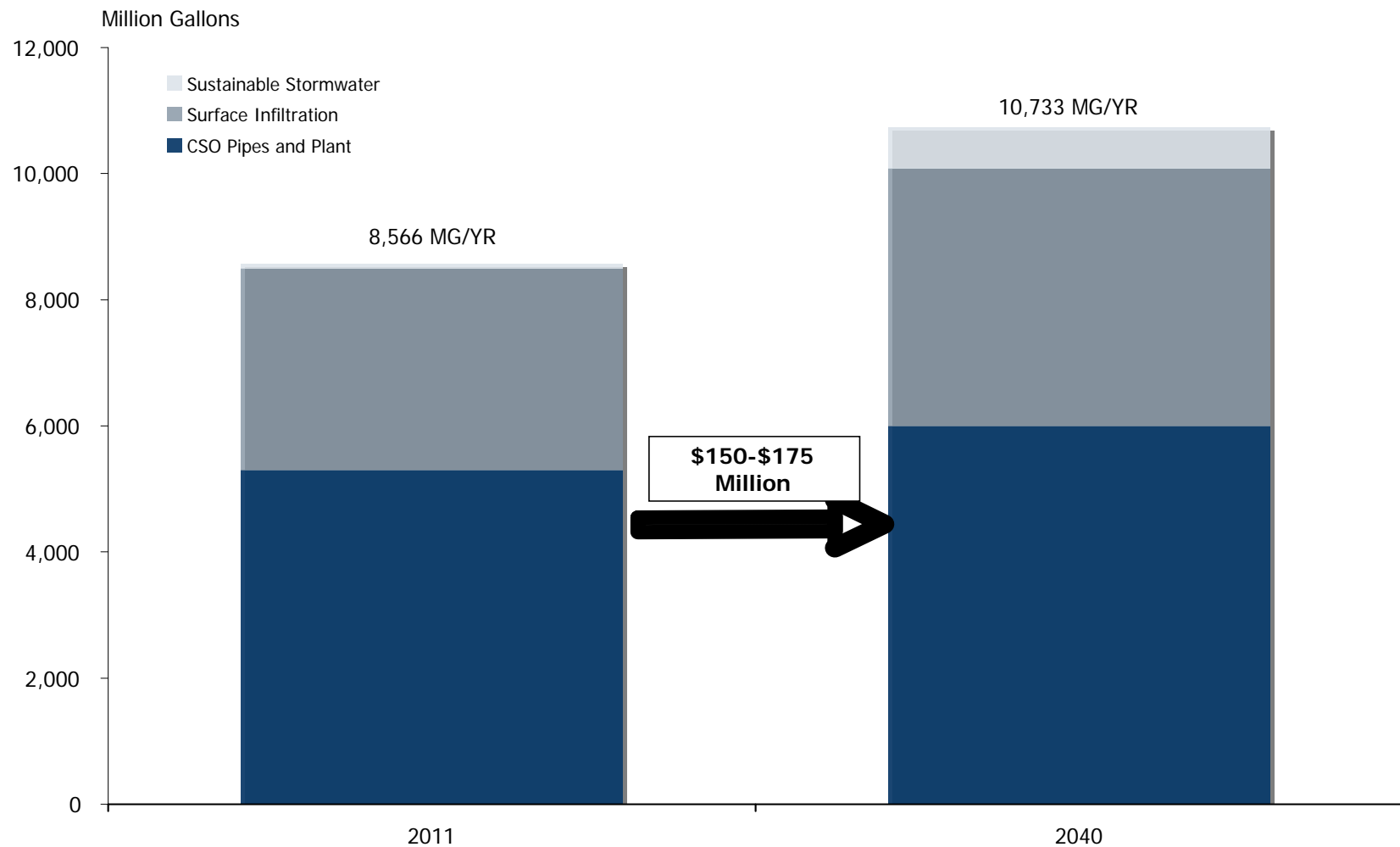
CSO Control Strategies

Planned Strategies to maintain CSO controls from 2011 through 2040



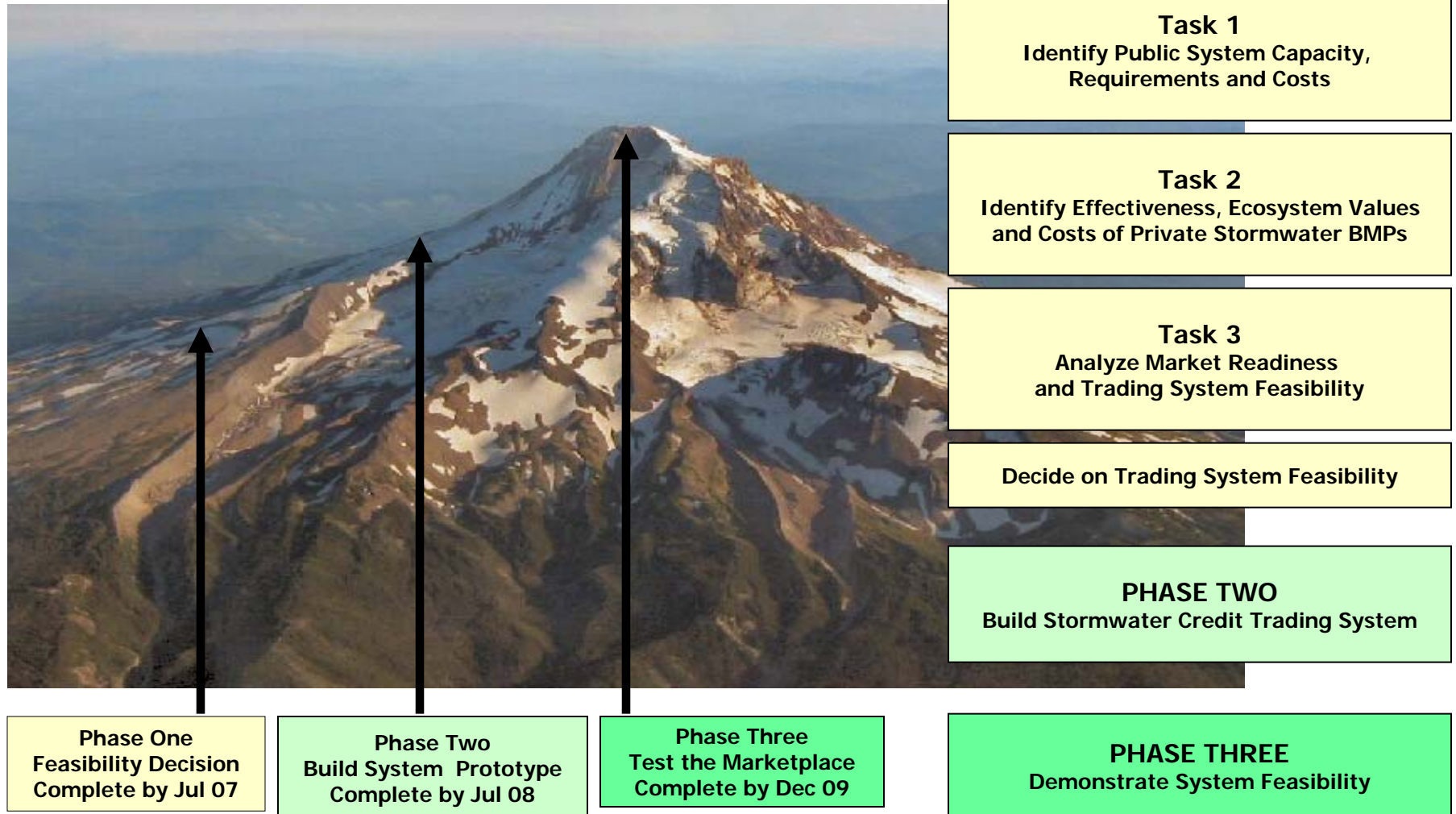
Challenge beyond 2011...

Increased density with add 2.2 billion gallons of runoff by 2040



Grant Proposal

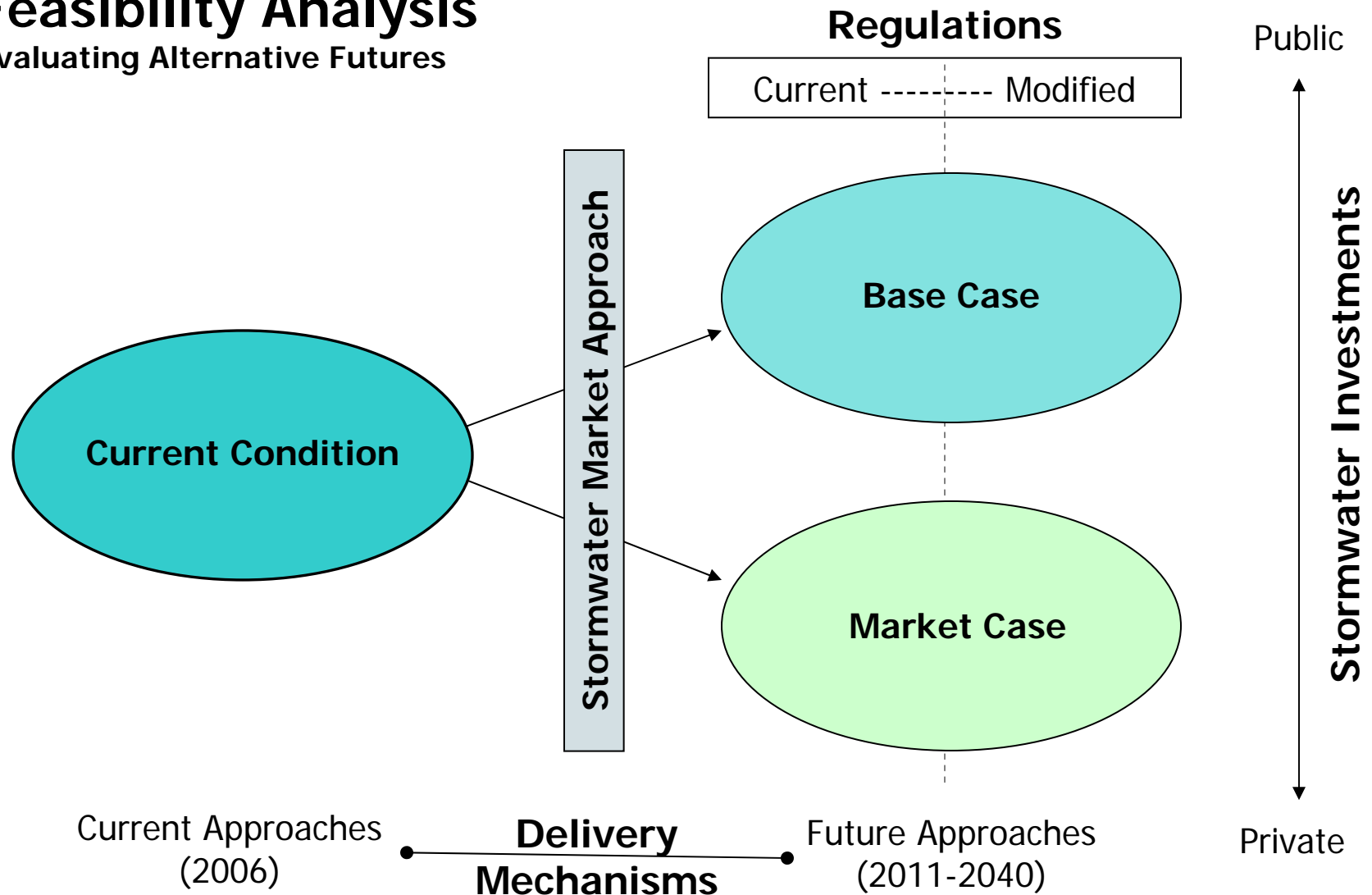
Phased Approach to Analysis and Program Development



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Feasibility Analysis

Evaluating Alternative Futures



Market Cases

Engaging Private Investments – Expanding Ecosystem Benefits

Alternative 1

- Optimize Cost and Volume Control
- Increase Private Investments

Cost
Volume Control
Private Investment – Regulatory Private Investment - Voluntary

Alternative 1b

- Optimize Cost and Volume Control
- Increase Private Investments
- Increase Street System Investments

Cost
Volume Control
Public Investment – Public Property Private Investment – Regulatory Private Investment - Voluntary

Alternative 2

- Optimize Water Quality Controls

Water Quality Control

Alternative 3

- Optimize Ecosystem Services

Ecosystem Services



Evaluation Tool

Weighing Costs and Benefits

Stormwater Marketplace Feasibility Study

Activity Types

Activity Type	Public Investment - Public Property	Public Investment - Private Property	Private Investment - Regulatory	Private Investment - Voluntary
Public Investment - Public Property
Public Investment - Private Property
Private Investment - Regulatory
Private Investment - Voluntary

Activity Types

Public Investment – Public Property
Public Investment – Private Property
Private Investment – Regulatory
Private Investment - Voluntary

BMP Characteristics

Cost

Capital, Design and O&M
Unit Cost per 1000 Gallons of Volume Control

Volume Control

Gallons of Volume Control per Acre per Year

Water Quality Control – BMP Effectiveness

Flow
Sediment (TSS)
Zinc
Pathogens
Phosphorous

Ecosystem Services – BMP Effectiveness

Air Purification
Carbon Sequestration
Flood Storage
Terrestrial Habitat
Aquatic Habitat
Urban Heat Island Effect
Aesthetics/Quality of Life



Evaluation Tool

BMP Characteristics

BMPs	Costs			Life Span (years)	Annual Stormwater Volume	
	Capital	Design	O&M		% Removed	% Overflow
Ecoroof	286,000	85,800	935	30	40%	60%
Drywell						
Drywell	21,552	2,155	25	25	100%	0%
Sump w/ Sed. Manhole	90,000	27,000	130	30	100%	0%
Flow-Through Planter - Roof Areas	100,000	30,000	2,287	30	25%	75%
Infiltration Planter						
Roof Area	85,000	25,500	2,000	30	50%	50%
Streets	100,000	30,000	2,287	30	50%	50%
Curb Extension	70,144	21,000	2,287	30	50%	50%
Pipe Separation	524,750	157,425	850	100	50%	50%
Porous Pavement						
New Construction	218,000	65,400	4,000	20	50%	50%
Retrofits	308,000	92,400	4,000	20	50%	50%
Sand Filter	56,100	16,830	1,100	30	0%	100%
Downspout Disconnection						
<i>School/Church</i>	18,000	3,000	25	30	40%	60%
<i>SF Residence</i>	23,100	2,900	25	30	40%	60%
Tree Planting	43,500	2,175	50	50	10%	90%
Other BMPs						
Flow Restrictor	15,000	4,500	130	10	0%	100%
Soakage Trench	110,000	33,000	550	15	100%	0%



Evaluation Tool

BMP Characteristics

BMPs	Tier 2 Effectiveness				
	Flow	Sediment	Zinc	Pathogens	Phosphorus
Ecoroof	60%	40%	28%	40%	40%
Drywell					
Drywell	100%	0%	0%	0%	0%
Sump w/ Sed. Manhole	100%	66%	2%	0%	2%
Flow-Through Planter - Roof Areas	85%	85%	90%	14%	50%
Infiltration Planter					
Roof Area	50%	50%	50%	50%	50%
Streets	50%	50%	50%	50%	50%
Curb Extension	95%	85%	90%	10%	70%
Pipe Separation	100%	0%	0%	0%	0%
Porous Pavement					
New Construction	77%	64%	35%	87%	25%
Retrofits	77%	64%	35%	87%	25%
Sand Filter	25%	42%	95%	93%	63%
Downspout Disconnection					
<i>School/Church</i>	40%	40%	40%	40%	40%
<i>SF Residence</i>	40%	40%	40%	40%	40%
Tree Planting	10%	42%	35%	0%	25%
Other BMPs					
Flow Restrictor	10%	0%	0%	0%	0%
Soakage Trench	100%	0%	0%	0%	0%



Evaluation Tool

Identifying Market Investments based on Objectives, Price, Effectiveness and Constraints

Strategies	Market 1 Optimize Cost Effectiveness	Market 1b Add Green Streets	Market 2 Optimize Water Quality	Market 3 Optimize Ecosystem Svcs
<i>Marketplace Investments – Millions of Gallons Managed</i>				
Downspout Disconnection	328	328	0	0
Tree Planting/Watershed Revegetation	71	71	0	266
Vegetated Filter Strip	290	290	325	354
Wet Pond	89	89	0	458
Drywell	883	883	227	449
Soakage Trench	555	555	227	227
Infiltration Planter	1,103	1,103	2,380	306
Ecoroof	52	52	185	222
Flow-Through Planter	227	227	382	227
Swale - Grassy and Vegetated	1,170	825	1,244	1,614
Porous Pavement	0	0	812	0
Vegetated Infiltration Basin	957	957	1,112	957
Total - Marketplace Investments	5,725	5,380	6,894	5,080



Evaluation Tool

Trading Direct Public Investments for Marketplace Trading

Investments	Base Case	Market 1 Cost Effectiveness	Market 1b Green Streets	Market 2 Water Quality	Market 3 Ecosystem Services
Pipe Separation	3,222	3,222	3,222	3,222	3,222
Sustainable Stormwater	172	172	172	172	172
NW Neighborhoods	4,145	4,145	4,145	4,145	4,145
Green Roof Legacy Project	149	148	148	148	148
Eastside School Disconnects	299	299	299	299	299
Eastside Church Disconnects	142	142	142	142	142
<i>Eastside Inflow Controls</i>	3,708	0	0	0	0
<i>Redevelopment with SWMM</i>	1,665	0	0	0	0
<i>Green Streets</i>	0	0	346	0	0
Public - Public	0	691	346	691	691
Public - Private	0	1,591	1,591	1,591	1,591
Private - Regulatory	0	832	832	832	832
Alternative SWMM	0	1,018	1,018	1,463	784
Private - Voluntary	0	1,593	1,593	2,317	1,182
Totals - Million Gallons Managed	13,502	13,853	13,854	15,022	13,208



Evaluation Tool

Comparing Marketplace Results to Portland's Base Case for Stormwater Management

	Base Case	Variance from Base Case			
		Market 1 Cost Effectiveness	Market 1b Green Streets	Market 2 Water Quality	Market 3 Ecosystem Services
Stormwater Management Costs					
Total Cost (\$millions)	\$263.90	(\$47.13)	(\$47.13)	\$32.16	\$36.29
Unit Cost per 1000 Gallons Managed	\$19.55	(\$3.90)	(\$3.90)	\$0.16	\$3.18
Market Credit Price per 1000 Gallons Managed	\$19.55	(\$9.84)	(\$9.84)	\$5.72	(\$5.44)
Managed Stormwater Volume per Year (MG)					
Public - Public	8,313	482	137	506	506
Public - Private	3,524	(1,909)	(1,909)	(1,933)	(1,933)
Private - Regulatory	1,665	(833)	(833)	(833)	(833)
Private - Alternative to SWMM		1,018	1,018	1,463	784
Private - Voluntary		1,593	1,939	2,317	1,182
Total Managed Volume (million gallons)	13,502	351	352	1,520	(294)



Evaluation Tool

Relative Gains and Losses – Variance of Market Alternatives to the Base Case

	Variance from Base Case			
	Market 1 Cost Effectiveness	Market 1b Green Streets	Market 2 Water Quality	Market 3 Ecosystem Services
<i>Stormwater Management Costs</i>				
Total Management Costs	-17.9%	-17.9%	12.2%	12.5%
Cost per 1000 Gallons Managed	-19.9%	-19.9%	0.8%	16.3%
Market Credit Price per 1000 Gallons Managed	-50.3%	-50.3%	29.3%	-27.8%
<i>Impervious Area Managed</i>				
Roof Areas	15.6%	15.6%	9.0%	12.5%
Parking Areas	-17.3%	-17.3%	9.8%	-13.0%
Streets	0.0%	0.0%	0.0%	0.0%
Total Imperious Area Managed	0.0%	0.0%	-0.1%	0.2%
<i>Volume Control</i>	2.6%	2.6%	11.2%	-2.2%



Evaluation Tool

Relative Gains and Losses – Variance of Market Alternatives to the Base Case

	Variance from Base Case			
	Market 1 Cost Effectiveness	Market 1b Green Streets	Market 2 Water Quality	Market 3 Ecosystem Services
<i>Tier 2 - Water Quality Controls</i>				
Flow	2.9%	2.9%	1.3%	-8.9%
Sediment	-18.6%	-18.6%	4.5%	0.8%
Dissolved Zinc	-23.4%	-23.4%	-7.6%	2.3%
Pathogens	37.1%	37.1%	107.3%	101.5%
Phosphorous	-16.8%	-16.6%	7.1%	-1.8%
<i>Tier 3 - Ecosystem Services</i>				
Air Purification	0.0%	0.0%	0.0%	0.0%
Carbon Sequestration	-23.0%	23.0%	-17.8%	1.2%
Flood Storage	-4.3%	-4.3%	-17.2%	6.7%
Terrestrial Habitat	-12.6%	-12.6%	-12.6%	28.6%
Aquatic Habitat	0.0%	0.0%	0.0%	0.0%
Urban Heat Island	152.5%	152.5%	122.8%	593.1%
Aesthetics/Quality of Life	152.5%	152.5%	122.8%	593.1%
Composite Score	26.5%	25.6%	17.8%	65.8%



Phase I - Lessons Learned

- There appears to be an adequate supply (sellers) for a stormwater marketplace
- There may be sufficient relative price differences to consider credit trades and auctions at the BMP level for selected comparisons, and across a package or “portfolio” of BMPs
- Refined inputs and sensitivity analyses are needed to be sure
- There are substantial opportunities to develop and deploy market mechanisms to animate demand (buyers), including heightened regulations and the effective use of City investments
- The costs of implementing a credit trading system may exceed the potential benefits unless the City can find partners to share the legal, administrative and technical burden



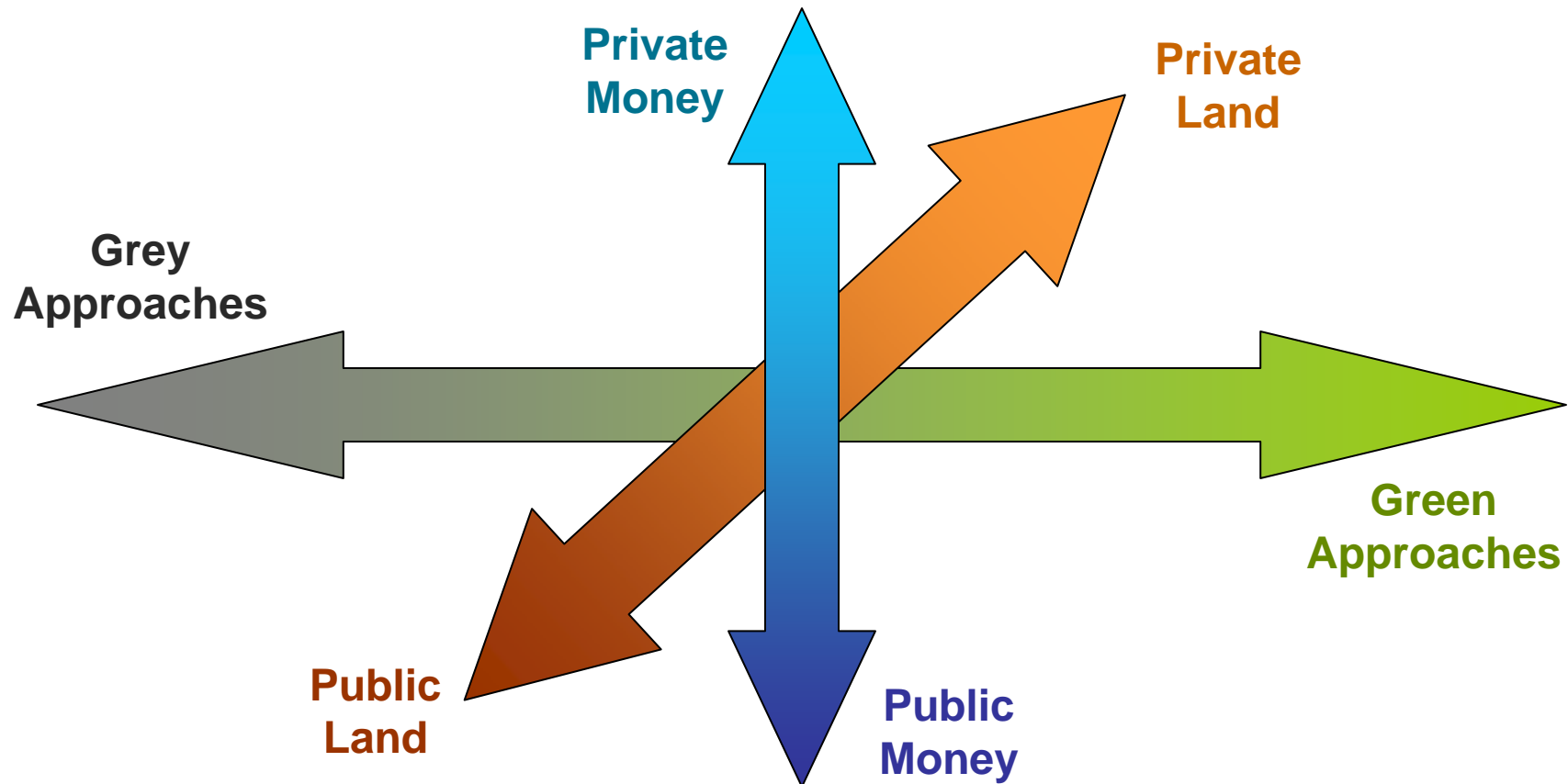
Phase I - Lessons Learned

- Evaluation and decision-making tools hold out great promise as aids to planning, program development, and decision-making
- More work is required...
 - Refine BMP cost and effectiveness information
 - Develop values for ecosystem service effectiveness
 - Integrate the “Tool” with systems modeling and asset management efforts
 - Expand the “Tool” to allow for site-specific and watershed-specific analysis
 - Use the “Tool” to make effective marketing and investment decisions



Phase I - Lessons Learned

We have a better idea about where we've been, where we are now, where we might want to go, and how to get there



Portland's Stormwater Marketplace

Current Examples of Market-Oriented Initiatives

Development Density Bonuses
Discounted Utility Charges
Downspout Disconnection Program
Watershed Stewardship Grants



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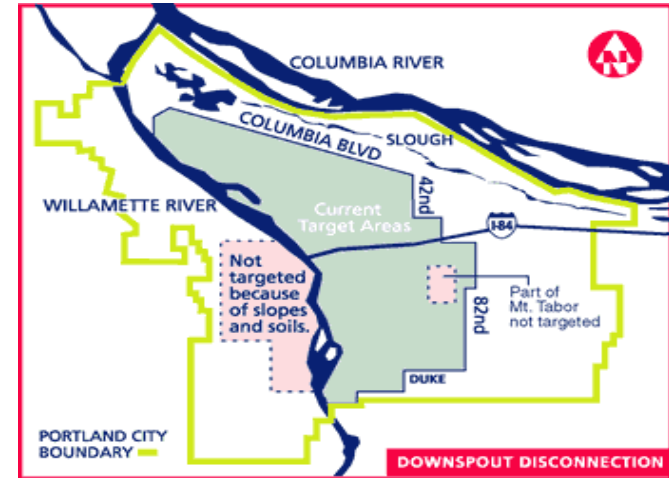
Development Density Bonuses

- Targets new developments in the Central City
- Developers receive a square foot of floor area bonus for each square foot of roof garden
- The ecoroof bonus ranges from 1:1 to 3:1 depending on the extent of the roof coverage
- Developers must record covenants to retain and maintain the green roofs... permanently
- The bonus has produced an estimated \$225 million in additional private development at 11 participating sites
- The program has spurred ecoroof developments outside of the target area... Portland has more than 120 ecoroofs in place and more are on the way



Downspout Disconnection Program

- Targets to homes and small businesses in combined sewer areas on the east side of the Willamette River
- Great opportunity for public education about stormwater and CSOs
- Property owners and community volunteers do the work after the City surveys each site and approves each disconnection
- Property owners receive \$53 per disconnected downspout... Community groups earn \$13 per disconnected downspout
- Since 1994, the program has reached 56,000 properties, 1.2 billion gallons of stormwater per year from the combined sewer system



Discounted Utility Charges

- Itemizes the stormwater bill into on-site and off-site stormwater management services
- Offers up to 100% discount of the on-site portion ... 35% of the total stormwater bill
- First discount comes with a retroactive credit worth as much as 12 months of the stormwater discount
- Discounts are calculated based on the extent and effectiveness of private facilities to control flow rate, pollution and disposal
- Since October 2006, the City has processed more than 33,000 registrations
- Full participation may reach 110,000 of the 176,000 stormwater ratepayers



Watershed Stewardship Grants

- Grants up to \$5,000 to community groups
- Focused on community-initiated projects to improve watershed health
- Fosters community partnerships and provides technical assistance, financial support and training to volunteers
- Projects have included ecoroofs, parking lot swales, habitat restoration and downspout disconnections
- Between 1995 and 2005, the program awarded 108 grants, engaging more than 27,000 citizens who donated nearly 140,000 volunteer hours
- Nearly \$450,000 in City grants have attracted more than \$1.9 in matching funds



Portland Responds to Baseline Questions

**Contribution to Sustainability
Surprising Results
Update on Collaborators
How has CNS Helped?
Desired Feedback**



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Contribution to Sustainability

Observations from 2006...

- Actors are able to quantify benefits derived from site-level investments
- Actions are more accountable since prices are linked directly to costs
- Improved accounting links individual actions to community and public goods
- Incentives create a “bias for action” independent of regulation
- Dispersed, small-scale facilities increase the resiliency of the overall system

Observations from 2007...

- Markets provide the “place” where the social, economic and ecological principles of sustainability are integrated and leveraged
- Markets increase the likelihood of sustainable investments by providing easy access to research, technical assistance, financing, incentives, supply chains and maintenance services
- Markets improve the sustainability of public investments and utility finances by shifting responsibility and costs to private actors and personal behavior



Surprising Results

Observations from 2006...

- Actors are able to quantify benefits derived from site-level investments
- Actions are more accountable since prices are linked directly to costs
- Improved accounting links individual actions to community and public goods
- Incentives create a “bias for action” independent of regulation
- Dispersed, small-scale facilities increase the resiliency of the overall system

Observations from 2007...

- Market forces are ever-present, awaiting animation and direction
- Public understanding of sustainability is increasing, approaching a tipping point
- Public understanding of the role of markets needs to catch-up
- Social networks and marketing strategies can play a critical role
- Sophisticated and expensive trading systems might need to follow more accessible and grass roots marketplace structures and strategies
- Institutional inertia is the most significant obstacle to any paradigm shift



Update on Collaborators

Observations from 2006...

- Inquiries are focused obstacles- permitting, regulation and transaction costs
- Coordination with regional marketplace initiative is essential
- Regulators (state and federal) are very interested
- Collaboration will increase in future phases

Observations from 2007...

- The project is moving from internal deliberations to a community conversation
- Project stakeholders and partners are interested and supportive
- Uncertainty remains when it comes to regulators and organized special interests
- The next phase will engage social networks to determine the ways and means of animating and directing market forces
- New initiatives will target the green economy, sustainability professionals and the supply chain of goods and services to serve individuals and communities



How CNS Has Helped?

Observations from 2006...

- Provided the necessary funding to get the work started
- Increased visibility, interest and knowledge of ecosystem services
- Provided the initiative for internal collaboration within Environmental Services
- Provided networking opportunities around the US and in DC

Observations from 2007...

- Created the occasion for a coming together of federal and state stakeholders from the Pacific Northwest
- Brought Dr. Garrett Louis into the project.. and his thoughtful inquiry into our methods of engaging stakeholders and decision-makers
- Increased our credibility in conversations with Congressional committees



Desired Feedback

Observations from 2006...

- Help document and check our assumptions and reduce our level of uncertainty
- Suggest ways to increase regulatory acceptance and flexibility
- Suggest ways to simplify a complicated subject and increase its accessibility to the public
- Help us see identify threats and risks, as well as opportunities facing our project

Observations from 2007...

- Help organize collaborative research and development programs to advance the following practical prerequisites of sustainable stormwater markets:
 - Methods and models for monitoring the effectiveness of sustainable stormwater facilities
 - subjective and objective values for ecosystem services
 - configurable software to operate credit trading registries
 - integration of local, regional, national and international marketplaces for ecosystem credit trading



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